CLEAN AIR ACT
INFORMATION PACKET

TO ACCOMPANY RELEASE
OF SECTION 812 PROSPECTIVE STUDY
NOV. 16, 1999

Experience with Clean Air Act implementation, bolstered by the section 812 study, demonstrates several lessons:

- The CAA is working. It has produced, and is continuing to produce, tremendous health and economic benefits.

- Costs of the 1990 amendments are turning out to be far less than industry estimated during reauthorization. One reason is that the Clean Air Act creates incentives for technology advances, and industry repeatedly has met challenges by developing cleaner technologies.

- Benefits typically are underestimated because even today it is impossible to translate many health and environmental benefits into dollar terms. Also, available scientific studies may provide incomplete information on health and environmental effects of pollution problems, and later studies may reveal additional effects or effects at lower levels. Examples from the past include acid rain, stratospheric ozone, lead and particulate matter.

- Experience shows that waiting for all uncertainties to be resolved before taking action to reduce air pollution could have tragic health consequences for the American people. We must take precautionary action when the weight of the evidence indicates a health or environmental threat.

Further information and examples are contained in the attached information packet.

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For more information on the Clean Air Act and EPA air programs, see the home page for the EPA Office of Air and Radiation on the web: http://www.epa.gov/oar/oarhome.html

I.

THE SECTION 812 STUDY OF CLEAN AIR ACT BENEFITS AND COSTS

FACT SHEET
Costs and Benefits of the Clean Air Act Amendments of 1990

EPA STUDY FINDINGS

- A November 1999 study by the Environmental Protection Agency -- "The Benefits and Costs of the Clean Air Act, 1990 to 2010: EPA Report to Congress" -- confirms that the large reductions in air pollution being achieved under the Clean Air Act Amendments of 1990 are protecting millions of Americans from health effects ranging from premature mortality to shortness of breath.

- This congressionally mandated study of Clean Air Act benefits and costs, the most comprehensive study of its type ever conducted, shows that the benefits of the 1990 Amendments substantially exceed the costs. Although any benefit-cost analysis of clean air programs involves significant uncertainties, the study's central estimate indicates that benefits exceed costs by a ratio of 4 to 1. This estimate does not take into account the many health and environmental benefits that could not be translated into dollar terms.

WHAT ARE THE HEALTH BENEFITS OF CLEAN AIR PROGRAMS?

- An important finding of the report is the significant number of illnesses and premature deaths avoided as a result of the 1990 Clean Air Act.

- Based on the study's central estimates, the reductions in ground-level ozone, particulate matter and associated pollutants achieved under Clean Air Act Amendments of 1990 are expected to avoid the following adverse health effects in a single year -- 2010:

    - 23,000 incidences of premature mortality
      20,000 cases of chronic bronchitis and 47,000 cases of acute bronchitis
    - 91,000 incidence-days of shortness of breath, 1,700,000 asthma attacks, and 7,200 cases of chronic asthma
    - 22,000 respiratory related hospital admissions, 42,000 cardiovascular hospital admissions, and 4,800 emergency room visits for asthma.
    - 4,100,000 lost work days and 31,000,000 days with restricted activity due to air pollution-related illness

- All of these benefits are in addition to a wide range of benefits that society has experienced as a result of the 1970 and 1977 Clean Air Act Amendments.

WHAT ARE THE EMISSION REDUCTIONS FROM CLEAN AIR PROGRAMS?

- Emissions of a wide range of air pollutants will be significantly lower than they would have been without the additional federal, state, and local clean air programs developed pursuant to the goals and requirements of the 1990 Clean Air Act Amendments. For example, by the year 2010 the following reductions are expected to be achieved, relative to levels projected without the 1990 Clean Air Act programs:

    - 35 percent less smog-causing volatile organic compound emissions;
    - 39 percent less smog- and particulate-forming nitrogen oxide emissions;
    - 23 percent less carbon monoxide emissions;
    - 31 percent less particulate-forming sulfur dioxide emissions;
    - significant reductions in other pollutants such as directly emitted particulate matter, mercury, and other toxic metal and toxic organic emissions; and
    - significant reductions in substances which deplete the protective layer of stratospheric ozone.

- It is important to note that benefits are often underestimated in cost/benefit analyses due to the fact that health scientists, ecologists, and economists have not yet developed the data and modeling tools needed to translate many health and environmental benefits into dollar terms. Furthermore, current scientific studies may provide incomplete information on health and environmental effects of pollution problems more of which may be revealed by later studies.

- However, experience shows that waiting for all uncertainties to be resolved before taking action to reduce air pollution could have tragic health consequences for the American people. Experience with pollutants such as lead, CFCs (chemicals that damage the stratospheric ozone layer), particulate matter, and acid rain shows the importance of taking action when the weight of the evidence indicates a health or environmental threat.

WHAT ARE THE COSTS OF CLEAN AIR PROGRAMS?

- Costs of pollution reductions to meet the 1990 amendments are turning out to be far less than original industry estimates. One of the reasons is that the Clean Air Act creates incentives for technology advances, and innovative companies have repeatedly met challenges by developing cleaner, more efficient technologies.

- EPA's study found that in 2010, the estimated cost of achieving reductions in six major pollutants under the 1990 Amendments is 27 billion dollars, compared with a central estimate of monetized benefits of 110 billion dollars. As noted above, any benefit-cost analysis of clean air programs involves uncertainties.

BACKGROUND ON COST AND BENEFITS REPORT

- Section 812 of the Clean Air Act Amendments of 1990 requires that the Environmental Protection Agency periodically assesses the effect of the Clean Air Act on the public health, economy, and environment of the country.

- In October 1997, EPA issued a Report to Congress called *The Benefits and Costs of the Clean Air Act: 1970 to 1990.* In 1991, as required by the Clean Air Act, EPA's Science Advisory Board formed an *Advisory Council on Clean Air Compliance Analysis.* This group of eminent, independent scientists and economists closely reviewed the design, implementation, results, and write-up of this retrospective study. The results of the retrospective analysis revealed that the benefits of the 1970 and 1977 Clean Air Acts have been tremendous, far exceeding the costs.

- The primary goal of Section 812 is to require EPA to perform thorough analyses of the costs and benefits of the Clean Air Act. EPA has now completed the first prospective analysis in this series of assessments, and the analysis demonstrates that –contrary to industry claims-- the benefits of the 1990 Amendments far exceed the costs.

- The retrospective and prospective studies are perhaps the most in depth look at the Clean Air Act that has ever been performed.

NEXT STEPS

- Many of the emissions reductions examined by the section 812 prospective study are already being achieved. Under the Clean Air Act, the nation has made great strides in combating each of the major pollution problems that faced the United States in 1990: urban air pollution, toxic air pollution, damage to the stratospheric ozone layer, and acid rain.

- But the nation still has a long way to go to reach the goal of clean air for every American. EPA is taking a series of actions to maintain the nation's progress in reducing ozone and particulate matter pollution, while litigation proceeds over the air quality standards for those pollutants.

FOR MORE INFORMATION

- This study as well as information about the retrospective study are available on the Internet at (http://www.epa.gov/oar/sect812)

- For further technical information on the report, contact Jim Democker at 202-564-1673, or E-Mail him at: democker.jim@epa.gov.

ADVERSE HEALTH EFFECTS AVOIDED IN 2010
(number of incidences)
based on criteria pollutant reductions under 1990 amendments

Health Endpoint	Pollutant	Mean Estimate
MORTALITY		
ages 30 and older	PM	23,000
CHRONIC ILLNESS		
chronic bronchitis	PM	20,000
chronic asthma	O3	7,200
HOSPITALIZATION		
respiratory admissions	PM, CO, NO2, SO2, O3	22,000
cardiovascular admissions	PM, CO, NO2, SO2, O3	42,000
emergency room visits for asthma	PM, O3	4,800
MINOR ILLNESS		
acute bronchitis	PM	47,000
upper respiratory symptoms	PM	950,000
lower respiratory symptoms	PM	520,000
respiratory illness	NO2	330,000
moderate or worse asthma[a]	PM	400,000
asthma attacks[a]	O3, PM	1,700,000
chest tightness, shortness of breath, or wheeze	SO2	110,000
shortness of breath	PM	91,000
work loss days	PM	4,100,000
minor restricted activity days/any of 19 respiratory symptoms[b]	O3, PM	31,000,000
restricted activity days[a]	PM	12,000,000

a These health endpoints overlap with the "any-of-19 respiratory symptoms" category.
b Minor restricted activity days and "any-of-19 respiratory symptoms" have overlapping definitions and are pooled.

Source: Table 5-3, Clean Air Act Section 812 prospective study, November 1999

Table ES-1
Summary Comparison of Benefits and Costs (Estimates in millions 1990$)

	Titles I through V	
	Annual Estimates	
	2000	**2010**
Monetized Direct Costs:		
Low [a]		
Central	$19,000	$27,000
High [a]		
Monetized Direct Benefits:		
Low[b]	$16,000	$26,000
Central	$71,000	$110,000
High[b]	$160,000	$270,000
Net Benefits:		
Low	($3,000)	($1,000)
Central	$52,000	$83,000
High	$140,000	$240,000
Benefit/Cost Ratio:		
Low[c]	less than 1/1	less than 1/1
Central	4/1	4/1
High[c]	more than 8/1	more than 10/1

[a] The cost estimates for this analysis are based on assumptions about future changes in factors such as consumption patterns, input costs, and technological innovation. We recognize that these assumptions introduce significant uncertainty into the cost results; however the degree of uncertainty or bias associated with many of the key factors cannot be reliably quantified. Thus, we are unable to present specific low and high cost estimates.

[b] Low and high benefits estimates are based on primary results and correspond to 5th and 95th percentile results from statistical uncertainty analysis, incorporating uncertainties in physical effects and valuation steps of benefits analysis. Other significant sources of uncertainty not reflected include the value of unquantified or unmonetized benefits that are not captured in the primary estimates and uncertainties in emissions and air quality modeling.

[c] The low benefit/cost ratio reflects the ratio of the low benefits estimate to the central costs estimate, while the high ratio reflects the ratio of the high benefits estimate to the central costs estimate. Because we were unable to reliably quantify the uncertainty in cost estimates, we present the low estimate as "less than X," and the high estimate as "more than Y", where X and Y are the low and high benefit/cost ratios, respectively.

Table 5-1
Human Health Effects of Criteria Pollutants

Pollutant	Quantified Health Effects	Unquantified Health Effects†
Ozone	Respiratory symptoms Minor restricted activity days Respiratory restricted activity days Hospital admissions- All Respiratory and All Cardiovascular Emergency room visits for asthma Asthma attacks	Mortality‡ Increased airway responsiveness to stimuli Inflammation in the lung Chronic respiratory damage / Premature aging of the lungs Acute inflammation and respiratory cell damage Increased susceptibility to respiratory infection Non-asthma respiratory emergency room visits
Particulate Matter (PM_{10}, $PM_{2.5}$)	Mortality* Bronchitis - Chronic and Acute New asthma cases Hospital admissions - All Respiratory and All Cardiovascular Emergency room visits for asthma Lower respiratory illness Upper respiratory illness Shortness of breath Respiratory symptoms Minor restricted activity days All restricted activity days Days of work loss Moderate or worse asthma status (asthmatics)	Neonatal mortality‡ Changes in pulmonary function Chronic respiratory diseases other than chronic bronchitis Morphological changes Altered host defense mechanisms Cancer Non-asthma respiratory emergency room visits
Carbon Monoxide	Hospital Admissions - All Respiratory and All Cardiovascular	Behavioral effects Other hospital admissions Other cardiovascular effects Developmental effects Decreased time to onset of angina Non-asthma respiratory emergency room visits
Nitrogen Oxides	Respiratory illness Hospital Admissions - All Respiratory and All Cardiovascular	Increased airway responsiveness to stimuli Chronic respiratory damage / Premature aging of the lungs Inflammation of the lung Increased susceptibility to respiratory infection Acute inflammation and respiratory cell damage Non-asthma respiratory emergency room visits
Sulfur Dioxide	Hospital Admissions - All Respiratory and All Cardiovascular In exercising asthmatics: Chest tightness, Shortness of breath, or Wheezing	Changes in pulmonary function Respiratory symptoms in non-asthmatics Non-asthma respiratory emergency room visits

† Some of the unquantified adverse health effects of air pollution may be associated with adverse health endpoints that we have quantitatively evaluated (e.g., chronic respiratory damage and premature mortality). However, it is likely that the value assigned to the quantified endpoint may not fully capture the value of the associated health effect (e.g., chronic respiratory damage may result in significant pain and suffering prior to mortality). As a result, we include such effects separately in the unquantified health effects column.

‡Appendix D includes detailed discussion of the scientific evidence for these potential health effects and includes illustrative benefit calculations for them. Current uncertainties in our understanding of these effects do not support including these quantitative estimates in the overall CAAA benefits estimate. However, ozone-related mortality may be implicitly quantified in the overall analysis as part of the PM mortality estimate because of the significant correlation between ozone and PM concentrations.

* This analysis estimates avoided mortality using PM as an indicator of the criteria air pollutant mix to which individuals were exposed.

Table 7-5
Ecological Effects of Air Pollutants

Pollutant	Quantified Effects	Unquantified Effects
Acidic Deposition	Impacts to recreational freshwater fishing	Impacts to commercial forests (e.g., timber, non-timber forest products)
		Impacts to commercial freshwater fishing
		Watershed damages (water filtration flood control)
		Impacts to recreation in terrestrial ecosystems (e.g. forest aesthetics, nature study)
		Reduced existence value and option values for nonacidified ecosystems (e.g. biodiversity values)
Nitrogen Deposition	Additional costs of alternative or displaced nitrogen input controls for eastern estuaries	Impacts to commercial fishing, agriculture, and forests
		Watershed damages (water filteration, flood control)
		Impacts to recreation in estuarine ecosystems (e.g. Recreational fishing, aesthetics, nature study)
		Reduced existence value and option values for non-eutrophied ecosystems (e.g. biodiversity values)
Tropospheric Ozone Exposure	Reduced commercial timber yields and reduced tons of carbon sequestered	Impacts to recreation in terrestrial ecosystems (e.g. forest aesthetics, nature study)
		Reduced existence value and option values for ozone-impacted ecosystems
Hazardous Air Pollutant (HAPS) Deposition	No service flows quantified	Impacts to commercial and recreational fishing from toxification of fisheries
		Reduced existence value and option values for non-toxified ecosystems (e.g. biodiversity values)

II.

THE CLEAN AIR ACT: GETTING RESULTS

CLEANING THE AIR:
PROGRESS SINCE 1990

The Clean Air Act Amendments of 1990 passed Congress with overwhelming support and were signed onto law by President Bush. This bipartisan legislation set ambitious air pollution reduction goals and was designed to achieve real results. Since then, the law has substantially reduced each of the major air pollution problems that faced the United States:

- **Acid rain.** Annual sulfur dioxide emissions, which react to form acid rain, have been cut by more than 5 million tons, relative to a 1980 baseline. Most of these reductions have been achieved from utility power plants through an innovative market-based pollution allowance trading system. As a result, rainfall in the eastern U.S. is as much as 25 percent less acidic, and some ecosystems in New England are showing signs of recovery. Ambient sulfate concentrations have been reduced, leading to improvements in air quality and significant health benefits. Requirements for nitrogen oxides controls for utilities already have begun reducing those emissions, and will achieve a 2-million-ton NOx reduction beginning this year.

- **Ozone layer depletion.** Production of the most harmful ozone-depleting chemicals has virtually ceased in the United States. These include CFCs, halons, methyl chloroform, and carbon tetrachloride. The phaseout will reduce U.S. incidences of non-melanoma skin cancer by 295 million during the period 1989 through 2075, as well as protect people from immune system suppression and eye damage leading to cataracts. Provided the U.S. and the world community maintain the commitment to planned protection efforts, the stratospheric ozone layer is projected to recover by the mid 21st century.

- **Smog and other common pollutants.** The air in our nation's cities is substantially cleaner than in 1990. Ground-level ozone pollution, particulate matter, and carbon monoxide pollution have all been reduced significantly, producing dramatic decreases in the number of areas in nonattainment. Based on 1996-1998 data:

  - Of the 42 areas designated in 1991 as having unhealthy levels of carbon monoxide, 36 have met the CO air quality standard.

  - Of the 98 areas designated as nonattainment for the one-hour ozone standard, 62 now have air quality meeting that standard.

  - Of the 85 particulate matter nonattainment areas, 68 now have air quality meeting the PM10 standard.

- **Pollution from motor vehicles and fuels**. Cleaner vehicles and cleaner fuels are one important reason that the nation's air quality is improving. Today, the average new car meeting Tier I standards in the 1990 amendments is 40 percent cleaner than the average new car was in model year 1990. Moreover, automakers have begun selling cars in the Northeast that are 50 percent cleaner than Tier I cars, and will make these available

nationwide by 2001, under an innovative agreement that EPA mediated among the states, U.S. auto companies and other stakeholders. Further reductions will be achieved by more stringent tier II standards in conjunction with low-sulfur gasoline. On the fuels side, 30 percent of the gasoline consumed in the U.S., in 18 states, is cleaner-burning reformulated gasoline, which reduces emissions of smog-forming VOCs and toxics.

Buses and trucks also are getting cleaner. Diesel-powered urban transit buses being built today release almost 90 percent fewer particulate emissions than buses built in 1990. Substantial emissions reductions also are being achieved for the first time through emissions standards for a variety of engines not used in highway vehicles -- including locomotives, bulldozers, marine vessels, and lawn and garden equipment.

- **Industrial air toxics.** Rules issued since 1990 are expected to reduce toxic emissions from industry by 1.5 million tons a year -- many times the reductions achieved in the previous 20 years. These air toxics rules for chemical plants, oil refineries, aerospace manufacturing and other industries also are achieving large reductions in smog-forming VOCs and particulates.

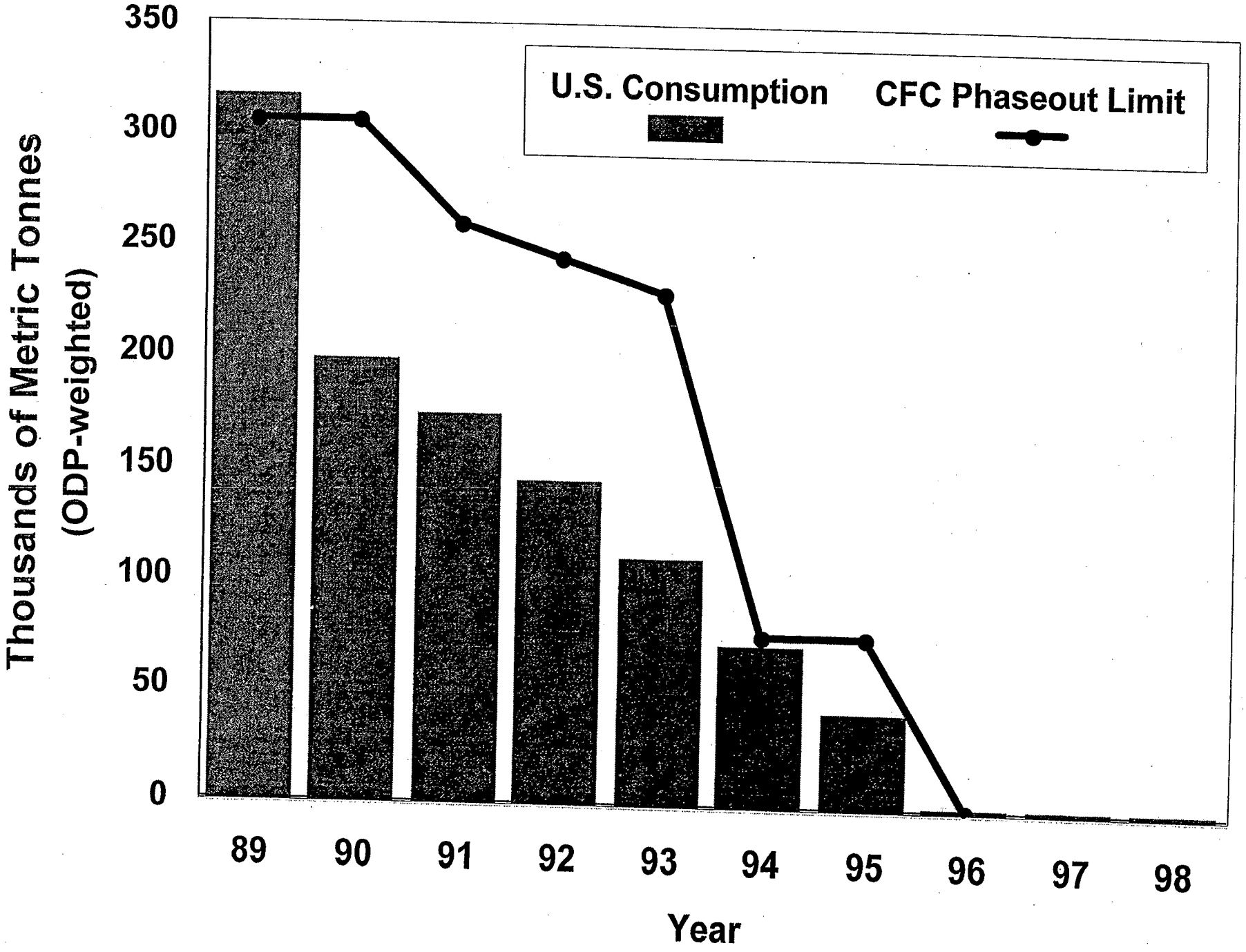
Overall, between 1990 and 1998, annual emissions of common air pollutants ("criteria pollutants") dropped by more than 10 million tons, and additional reductions will be achieved by rules already in place. These results have been achieved through a combination of rules, voluntary measures, market mechanisms, state partnerships, and stakeholder negotiations.

To recap: The Clean Air Act is working. Although significant pollution problems remain, the law has substantially reduced each of the major air pollution problems that faced the United States in 1990.

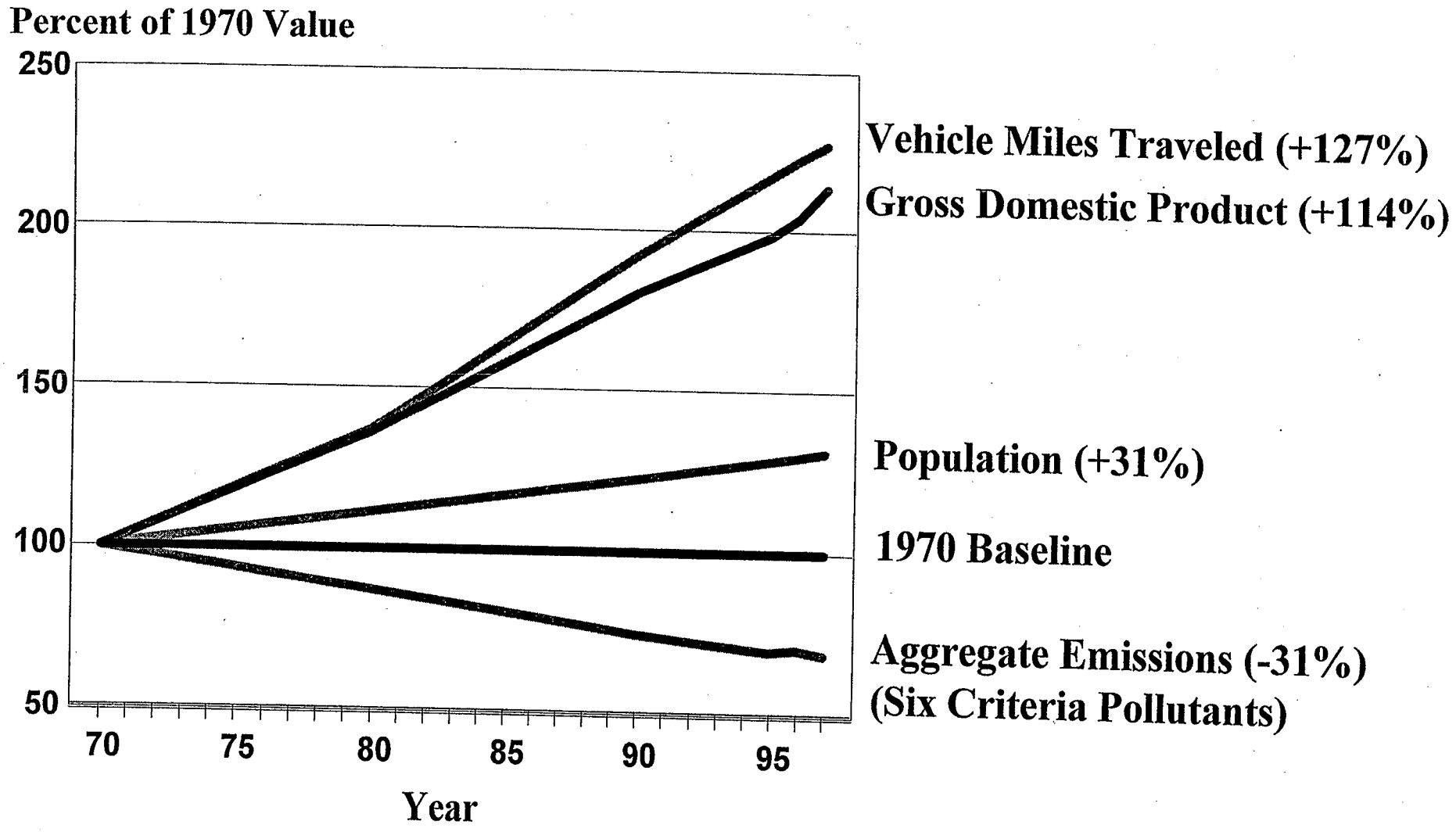
Emissions of All Pollutants Down, Except NOx

Pollutant	Emissions % Change 1970-1997
Lead	-98% ↓
Particulate Matter (PM10)	-75% ↓
Sulfur Dioxide	-35% ↓
Volatile Organic Compounds	-38% ↓
Carbon Monoxide	-32% ↓
Nitrogen Oxides	+11% ↑
NOx Emissions from Coal-Fired Power Plants	+44%

U.S. CFC Consumption



Air Quality Improvement & Economic Growth in the U.S.



III.

NEW INITIATIVES TO REDUCE SMOG AND PARTICULATE MATTER

MAINTAINING THE MOMENTUM TOWARD CLEAN AIR: NEW ACTIONS TO REDUCE SMOG AND PARTICULATE MATTER

Since May, a federal court ruling has delayed implementation of the new, more protective health standards EPA established in 1997 for ground-level ozone and fine particle pollution. The decision challenged EPA's legal rationale for the standards, but did not question the underlying science. Currently, EPA is recommending an appeal of the decision to the Supreme Court. The Agency continues to believe these standards are essential for protection of public health, and ultimately will be implemented.

In the meantime, Administrator Carol Browner is determined to keep EPA's emission reduction initiatives on track and to work with states to reduce health threats from smog and particulate matter. EPA recently has announced a series of actions to ensure continued progress:

- Tier II/Gasoline Sulfur. The Agency is on track to issue more stringent Tier II emissions standards for cars and light-duty trucks along with rules to cut levels of sulfur in gasoline. Many metropolitan areas need the emissions reductions from these rules to achieve healthy air. These final rules will cut nitrogen oxides and other emissions that contribute to ground-level ozone pollution and particulate matter, acid rain, crop damage and reduced visibility.

- Heavy Trucks and Buses/Diesel Sulfur. Administrator Browner in October announced a strategy to reduce by more than 90 percent harmful levels of smog-causing NOx and particulate matter from heavy duty trucks and the very largest sport utility vehicles. The strategy includes a plan to produce cleaner diesel fuel.

- Regional NOx Reductions. EPA will soon take final action on petitions from eight northeastern states, including NewYork and Pennsylvania, which call upon EPA to impose NOx controls on power plants and large industrial combustion sources in 12 upwind states. This action would reduce long-range transport of NOx and ozone pollution that is contributing to nonattainment problems downwind, as well as reducing pollution in states where the sources are located. EPA also will propose action on petitions recently received from additional states. EPA still plans to implement an already issued rule (known as the "NOx SIP call") that more broadly requires 22 eastern states to cut NOx emissions that contribute to the regional ozone problem, assuming legal challenges to the SIP call can be surmounted.

- Ozone Attainment SIPs. For 10 ozone nonattainment areas classified as serious or severe, EPA is assessing state plans for demonstrating attainment of the one-hour ozone air quality standard, which remains in effect for these areas. It appears that many of these areas will need to commit to additional emissions control measures and/or make other improvements in their plans before they are approvable. EPA plans to propose action on these plans in late November.

- Nationwide reinstatement of the one-hour ozone air quality standard. Since issuing the more protective 8-hour ground-level ozone standard in 1997, EPA has revoked the one-hour standard in nearly 3,000 counties (wherever ozone levels met the old standard). But the NAAQS court opinion leaves much of the nation without an adequately enforceable ozone standard to guard against deterioration in air quality. As a result, EPA recently proposed reinstating the old one-hour ozone standard nationwide.

11/16/99

IV.

THE CLEAN AIR ACT EXPERIENCE: PREDICTIONS VS. REALITY

CLEAN AIR ACT COSTS: PREDICTIONS VS. REALITY

The Clean Air Act Amendments of 1990 have achieved substantial reductions in air pollution at reasonable cost, without the serious economic disruptions predicted by some critics. Costs of the 1990 amendments are proving to be far less than initial industry estimates.

One reason is that the act's requirements have created pressures and market opportunities for technological innovation. Technology breakthroughs also have enabled the nation to achieve pollution reductions that some had predicted to be simply infeasible.

Examples of past predictions

Acid rain program. A utility industry study in 1989 predicted the cost of fully implementing an acid rain SO2 program at $4.1 billion to $7.4 billion annually. More recent estimates by EPA (including the November 1999 Section 812 study) and the U.S. General Accounting Office put these costs at approximately $2 billion, and estimates from independent economists and industry researchers range as low as $1 billion.

Reformulated gasoline. In 1993, the oil industry estimated that meeting the Act's requirements for reformulated gasoline would add 16 cents to the price of a gallon of gas. In 1995, the year the program took effect, an Energy Information Administration survey found that the difference in price between reformulated and conventional gasoline was 3 cents to 5 cents per gallon. In November 1999, the EIA survey showed the price difference was only a penny a gallon.

VOC controls to reduce ground-level ozone pollution. The Clean Air Working Group, a key industry lobbying group during the 1990 reauthorization effort, said in August 1990 that stationary source VOC control requirements later enacted as part of Title I of the 1990 amendments would cost an estimated $14.8 billion per year. With the benefit of updated information, EPA (based on its November 1999 Section 812 study) now estimates the cost of Title I stationary source VOC controls at approximately $3.9 billion in 2010.

Protection of stratospheric ozone layer. A chemical company spokesman testified in January 1990 that accelerating the phase-out of ozone-depleting CFCs to January 1996 would cause severe economic and social disruption. At the same hearing, a refrigeration industry representative testified, "We will see shutdowns of refrigeration equipment in supermarkets....We will see shutdowns of chiller machines, which cool our large office buildings, our hotels, and hospitals." In fact, the phase-out of CFC production was accomplished without such disruptions. Chemical companies helped make this possible by rapidly developing alternatives to CFCs.

Motor vehicle emissions standards. A major American auto company representative in 1989 testified that "we just do not have the technology to comply" with the initial Tier I tightening of tailpipe standards that became part of the 1990 amendments. Nonetheless, the auto industry was able to begin producing vehicles meeting the standards in 1993. More recently, the auto industry

entered into a voluntary agreement with EPA and states to produce even cleaner, low emission vehicles that are already being sold in some areas and will be available nationwide in 2001.

Technology Innovation and the Clean Air Act

As some of these examples show, the Clean Air Act has helped lead to technology innovation and performance improvements. Over and over again, innovative companies have responded with great success, producing breakthroughs such as alternatives to ozone-depleting chemicals and new super-performing catalysts for automobile emissions.

There are many examples of technologies that were not commercially available a dozen years ago, but that now are important parts of pollution control programs. These include:

- Selective Catalytic Reduction (SCR) for NO_x emissions from power plants
- Gas reburn technology for NO_x
- Scrubbers which achieve 95% SO_2 control on utility boilers
- Sophisticated new valve seals and detection equipment to control leaks
- Water and powder-based coatings to replace petroleum-based formulations
- Reformulated gasoline
- LEVs (Low-Emitting Vehicles) that are far cleaner than had been believed possible in the late 1980s (an additional 95% reduction over the 1975 controls)
- Reformulated lower VOC paints and consumer products
- Safer, cleaner burning, wood stoves
- Dry cleaning equipment which recycles perchlorethylene
- CFC-free air conditioners, refrigerators and solvents

This pattern of technological progress is continuing today. In the regulatory impact statement for the 1997 ozone and PM NAAQS, EPA identified a number of emerging technologies -- ranging from fuel cells to ozone-destroying catalysts to new coating technologies -- that may hold promise for achieving additional cost effective reductions of VOC, NOx and particulate matter. Similarly, the University of California-Riverside's Center for Environmental Research & Technology has identified a long list of new and emerging technologies that may help achieve cleaner air in the 21st century (see attached document). EPA can help foster demand for clean technologies by promoting market-based strategies that create a market for the most efficient, best performing technologies.

Conclusion

The Clean Air Act Amendments of 1990 have substantially improved the nation's air quality – at costs substantially less than initially predicted by industry. One reason is that the act has created market opportunities and has promoted technological innovations. This has helped the nation achieve cleaner air in conjunction with strong economic growth.

Document prepared for the U.S. Environmental Protection Agency by the University of California- Riverside, Bourns College of Engineering, Center for Environmental Research & Technology -- October 1999

Examples of Emerging Technologies for the 21st Century

It seems that the technological innovation that has been spurred to date by Clean Air Act requirements is just the tip of the iceberg. Hundreds of new products are under development, in testing, or coming into the market that will further help meet air quality requirements. The following list includes new and emerging technologies that can help to reduce air pollution emissions and may help achieve cleaner air for all Americans in the 21st Century.

1. Mobile Source

Fuel Cell and Electric and Electric Hybrid Vehicles

GM Fuel Cell Electric EV1
GM Parallel Hybrid EV1, Series EV1
Nissan Motor Corporation Altra EV
DaimlerChrysler New Electric Car (NECAR) 4
Solectria Corporation Solectria Sunrise
Zevco Millennium Taxi
Toyota FCEV
Toyota e·com
Toyota Prius Sedan
Dodge Intrepid ESX2
Robert Wright & Company ECE City Bus
Chrysler Motor Corporation 1999 Electric Minivan (EPIC)
TH!NK Nordic AS TH!NK (EV)
Volvo Power Split Hybrid Research Car
Honda Insight (hybrid electric)

Alternative Fuel Vehicles

GM CNG EV1
Toyota Camry CNG
Honda GX (Natural Gas)
Ford Crown Victoria Dedicated NGV
DaimlerChrysler 1999 NGV RAM Van/Wagon
Ford Econoline Dedicated NGV
Ford F-Series Dedicated NGV
Warsitz Hydrogen Spirit

Hybrid Electric Buses and Trucks

Coval H2 Partners T-1000 Neighborhood Truck
ISE Research Corporation ThunderVolt 701 and ThunderVolt 801-H (Heavy Duty Electric Trucks)
Canadian Electric Vehicles Ltd Might-E-Truck
Toyota Motor Corporation Coaster (Hybrid Bus)

Alternative Fueled Trucks & Engines

Chevrolet/GMC Medium Duty Conventional Truck
Mack Trucks E7G Natural Gas Series (LE and MR)
GMC Sierra Bi-Fuel CNG Pickup
PowerTech 8.1 L CNG Engines
Fiba Canning CNG & LNG Industrial Heavy duty Vehicles
John Deere 6081H Natural Gas
Cummins C8.3 G and 10 G (CNG/LNG)
Caterpillar 3176B, C-10, C-12 (CNG/Diesel dual fuel)
Detroit Diesel Series 50G/60G Natural Gas
Detroit Diesel Ethanol Series

Cleaner Small Engines

eCycle Inc. eCycle (electric)
Zap Bikes Electricycle(electric)
Electric MotorBikes Inc. Lectra (electric)
Corbin-Pacific, Inc. Sparrow P.T.M. (electric)
Advanced Engine Technologies, Inc. OX2 Internal Combustion Engine

Other Mobile Source Air Pollution Reduction Devices (all in R&D stage)

FUELS

ELF Aquitaine Aquazole (Diesel fuel)
TCPI, Inc Dr. Diesel™ (Diesel fuel additive)
AG Environmental Products, L.L.C SoyGold Marine™ (Marine Fuel Additive)
AG Environmental Products L.L.C SoyDiesel (diesel fuel additive)

ENGINES

Toyota Motor Corporation Direct-Injection 4-Stroke Gasoline Engine
Volvo Car Corporation Volvo Petrol Direct Injection
Caterpillar Dual-Fuel Engines (CNG, LNG, Diesel)
Honda ZLEV and Integrated Motor Assist

CATALYSTS & OTHER POST COMBUSTION TECHNOLOGIES

Engelhard Corporation PdPLUS™ catalyst PTX Catalyst TriMax™ Catalyst
Volvo Car Corporation Chemically Heated Catalyst
National Renewable Energy Laboratory and Bentler Industries Variable Conductance Insulation (VCI) catalytic converter
Siemens Automotive SINOx
Volvo Car Corporation and Engelhard Corporation PremAir™ catalyst
Johnson Matthey Cam Converter Technology (CCT™)
Engelhard Corporation DPX Soot Filter & STX Diesel Soot Filter
Engelhard Corporation CMX Converter Muffler
National Renewable Energy Laboratory and Benteler Industries Vacuum-Insulated Variable Conductance Catalytic Converter

OTHER

Volvo Car Corporation Integrated Starter Generator
Engelhard Corporation: GPX Coatings (applied to internal combustion components to reduce emissions, improve fuel economy and increase power output)

2. Stationary Source

Renewable Resource Fuels & Energy

Biomass

Hynol High Efficiency Biomass Fuel Production Process (currently in testing at the University of California Riverside)
Syntroleum Corporation The Syntroleum Process®
BG Technologies LLC BG Systems (biomass conversion system)
Synergy Technologies Corporation Syngen
FLS miljo Group Biomass-fired Boiler

Solar

Solar Energy Limited Hydro Air Renewable Power Systems (HARPS)
BP Solar EUCLIDES™ Concentrator
BP Solar APOLLO® Thin Films
BP Solar LGBG Mono-Crystalline Modules
Green Mountain Solar℠ Polycrystalline Modules
SunLab Solar Two
UNI-SOLAR Electric Modules
Siemens Solar Industries Copper Indium DiSelenide (CIS) thin film modules

Wind Power

Southwest Windpower AIR wind module
Advanced Wind Power, Inc. AWT-26
New World Power Technology North Wind 250
Zond Systems Z-40

Energy Reduction Devices

AMCEC Inc AMCEC ECOVAP (latent heat recovery process)
Praxis Engineers, Inc BANCS (control system)
National Renewable Energy Laboratory (NREL) Energy-10 (energy-efficient software for new buildings)
Praxis Engineers, Inc PECOS™ & SCYCLOPS™ (plant optimization software)
Power Integrations, Inc. TinySwitch Integrated Circuit (electrical reduction chip)
Syntha Corporation Syntha 2000 (plant optimization software)

Stationary Fuel Cells

Energy Research Corporation Direct Fuel Cell (DFC)
Zevco Alkaline Fuel Cell
BCS Technology Forced-Flow PEM Fuel Cell
H Power Corporation EPAC™, PowerPEM®-D35, PowerPEM®-PS250, PowerPEM®-RW35, PowerPEM®-SSG50
Energy Partners NG2000
Ceramic Fuel Cells Ltd. Ceramic Fuel Cell
Global Thermoelectric R & D Solid Oxide Fuel Cell
Warsitz WFC 25 and WFC 50 Series High Performance Fuel Cells

Catalysts

General Catalysts

CO/VOC
Goal Line Environmental Technologies LLC ADCAT™ CO Oxidation Catalyst
Johnson Matthey DualOx™Catalyst
Engelhard GEN™ diesel oxidation catalyst
MIRATECH Corporation Oxidation Catalyst
Glenro Catalytic Fume Oxidizer (used in hot air drying ovens.)
Prototech Company PRO*PEL-VOC pellets
Prototech Company PRO*BROIL™ catalyst (restaurant applications)
Engelhard Corporation CharCat900 Catalyst (restaurant applications)
Smith Environmental Corporation Catalytic Oxidizers, Direct-Fired Oxidizers, Smith PTO™ system
Goal Line Environmental Technologies SCOVOx

NOx
Detroit Stoker Company METHANE de-NOx™
Johnson Matthey SCR Catalyst
Engelhard VNX™ Catalyst
Catalytica Combustion Systems XONON™ Combustion System
Catalytic Combustion Corporation Monolith Catalysts

Other
Casso-Solar Gas Catalytic Heaters (used in Infrared (IR) heating systems)

Regenerative Catalytic Oxidizers
Huntington Environmental Systems Econ-Abator® Regenerative Catalytic Oxydizers & Econ-Nox™ Catalysts
Huntington Environmental Systems HES/RCO
Johnson Matthey RCO Catalyst
Goal Line Environmental Technologies SCONOx™ Catalyst System

Regenerative Thermal Oxidizers
Huntington Environmental Systems HES/RTO
Adwest Technologies, Inc RETOX® Regenerative Thermal Oxidizers
Durr Environmental, Inc Reeco RE-THERM® RL
Durr Environmental, Inc TAR Recuperative Thermal Oxidizer
Durr Environmental, Inc Ecopure® – Recuperative Thermal Oxidizer
Smith Environmental Corporation Smith RTO/TCO
Smith Thermal Recuperative Oxidizer SCO

Ozone Destroying Catalyst
Volvo Corporation & Engelhard Corporation Premair

Ultra Low-NOx Gas Fired Burners

Bloom Engineering Co Gemini Ultra^2 Low NOx Burner Series
Combustion Tec Throughport Fishtail Burner & Inline Burner Firing
Combustion Tec Oxygen Enriched Air Staging
Coen Company Distributed Air Flow (DAF) Low NOx Burner
Clayton Industries Low NOx/CO Steam Generators
Coen Company Quantum Low NOx (QLN) burner

John Zink Company Cool Fuel (low NOx burner retrofit)
Detroit Stoker Company DETROIT® DB Low NOx Burner
Dyson Hotwork Limited Low NOx Regenerative Burner
Energy and Environmental Research Corporation FlamemastEER &EER Reburn Process
FLS miljo Group Benson-Type Power Station Boiler
Radian International Radian Rapid Mix Burner (RMB)
Parker Boiler Company Premix Metal Fiber Burner

Coating Technologies

Low VOC primers & coatings
United Coatings ACRYLEX 300 acrylic metal primer, and Primer 707 wood primer
American Formulating and Manufacturing low VOC interior and exterior primer
American Formulating and Manufacturing Safecoat Enamels
Benjamin Moore & Co. Eco Spec Interior Latex Flat 219 Semi-Gloss 224
United Coatings Interior and Exterior flat paints and roof coating
Madison Chemical Industries, Inc. Madison Alumizinc 2000™ (primer/coating on tanks)
Madison Chemical Industries, Inc. Madison Corropipe II TX-15 pipe coating

Zero VOC primers & coatings
Evans Manufacturing, Inc Evans Peel Coat, Type I, II, III & IV coatings
Silvertown Products, Inc. Wood Defense wood finish
NonToxiCA Inc. Interior Flat Paint Series 100-I, and interior satin Series 200-I paint
Spectra-Tone® Paint Corporation Spectra-Tone® Enviro Interior Enamel (8800) & Semigloss (9900)
Vianova RESYDROL® Emulsions coatings, high gloss enamels, and wood stains and varnishes
Electrostatic Technology, Inc. ETI Powder Coating System
Madison Chemical Industries, Inc Madison Corrocote II PW™ water pipe sealer
Madison Chemical Industries, Inc Madison Corrocote II Plus™ underground tank sealer
Madison Chemical Industries, Inc Madison Marithane II Multi marine coating

Material Application Technologies
American Turbine, Inc. HVLP AT-Series
Lemmer Spray Systems Ltd. Lemmer T-55 HVLP
The Better Paint Tray LLC
Nordson Corporation Centuty® Selective Conformal Coating System

Solvent-Free Adhesives and Cleaners

Low VOC Metal and General Cleaners
Durr Environmental KFA (carbon fiber adsorption)
Detrex Corporation Modular Detrex batch cleaning system
Epcon® Industrial Systems, Inc. Epcon® Deoilers
Micro Care Corporation ExPoxy™ Remover
PCI of America HURRISAFE brake cleaners, carburetor, high pressure degreasers
Sulzer Metco Plasma Spray
Micell Technologies Inc. Miclean™ degreaser
PCI of America HURRISAFE 9000 series (general cleaners)
CRC Industries HydroForce™ Butyl-Free All Purpose Cleaner
Micro Care Corporation VeriClean Flux Remover

Zero-VOC Metal & Parts Cleaners
NW Technologies, Inc PC Series
Oakite Products, Inc Oakite® Gardoclean A5502
RotoJet of America Co., Roto-Jet Spray Washing Cabinet
ChemFree™ Corporation ChemFree SmartWasher®, SmartWasher® Supersink
Detrex Corporation Detrex Series rotating basket washer and spray jet parts washer
Kleer-Flo Company Greaseoff™ multi-metal cleaner
CAE Alpheus Inc CO_2 MiniBlast ™ Model SDI-5
Drumbeaters of America, Inc Cryo-Cleaner® System

Zero-VOC Electronic Parts Cleaners
Micro Care Corporation OS-20 Precision Cleaner
Smart Sonic Corporation SmarTsonic® Model 2000 & Model 4200

Other Solvent Related Technologies
TransGlobal Environmental Products TranSolv Technology (recycles industrial solvent waste)
John Zink Series 2000™ Vapor Combustion System
AMCEC Inc Solvent Recovery Systems
Baker Furnace, Inc BIOTON® (biological oxidation system)
Geomembrane Technologies, Inc Membrane Cover and Liner Systems

3. Other Cleaner Consumer Products

Lawn & Garden

Lawn-Boy Electric Series of Lawnmowers
Toro® CareFree electric mowers
Black & Decker CMM1000 electric Lawnmower
GrassMasters LawnPup
Ryobi Outdoor Products, Inc. TrimmerPlus 1090r (electric trimmer)

Clean Power & Fuels

United Solar Systems Corporation Unipower USF-32, USF-11, USF-5 (portable solar battery chargers)
Green Mountain Energy Resources Solar℠ Thin Films for rooftops
Solarex Millennia™ (rooftop solar cells)
ACR Solar International, Inc. Fireball 2001(solar water heater)
Warsitz Enterprises, Inc. HydroGrill™ (barbeque)
Warsitz Enterprises, Inc. RoamPower™ (portable Hydrogen power)

ICAC INSTITUTE OF CLEAN AIR COMPANIES

NEWS

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IMPROVED AIR POLLUTION CONTROL TECHNOLOGY MARKETS TO CONTINUE AT LEAST THROUGH 2002

Total Air Pollution Control Technology Market to Hover Around $3 Billion a Year

Washington, D.C. The Institute of Clean Air Companies, Inc. (ICAC), forecasts that the overall U.S. market for air pollution control and monitoring technology, which has risen significantly from levels earlier this decade, will increase gradually at least through 2002. Most technology sectors of the overall industry will increase marginally over this time frame, and the largest sector will be for NO_x controls.

Commenting on these findings, ICAC Executive Director Jeff Smith stated: "The air pollution control and monitoring technology industry is ready to respond with cost-effective compliance solutions to this increased need to reduce emissions of air pollutants".

The 72-page *Market Forecast* analyzes the U.S. market for electrostatic precipitators, fabric filters, VOC and NO_x control systems, wet particulate scrubbers, flue gas desulfurization systems, and continuous emission monitors annually through year 2002. The report also estimates aftermarket bookings.

"The forecast shows that the markets for most individual technology sectors in the industry will remain strong, giving the air pollution control technology industry some momentum over the forecast period, a positive change from the relatively low business volumes that characterized the industry earlier this decade. The industry welcomes the forecasted trends, and is optimistic that clean air initiatives and economic growth will sustain this momentum beyond the 2002 forecast horizon. Full, common-sense implementation and enforcement of the Clean Air Act — which opinion polls show that the U.S. public enthusiastically supports to protect its health and environment — will pay a dividend of new American jobs in the engineering and construction industries as these pollution control technologies are installed," Smith added.

Accompanying each product forecast is an analysis of market trends and the technological, regulatory, and general market influences. Historical statistics and a statistical forecast summary in both constant and inflated dollars are also included.

ICAC's September 1999 *Market Forecast* is available ($795) to the public. To order, send a check or purchase order to ICAC, 1660 L Street, N.W., Suite 1100, Washington, D.C. 20036. To place a telephone order using AMEX, or to request a free copy of the report's table of contents, call ICAC's Sharon Jenkins, tel: 202.457.0911.

ICAC is the nonprofit association of companies that supply air pollution control technology and monitoring systems. Its mission is, in part, to work to assure clean air policy that promotes public health, environmental benefit, and industrial progress. [end]

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INSTITUTE OF CLEAN AIR COMPANIES

WHY IS THE U.S. ENVIRONMENTAL PRODUCTS INDUSTRY IMPORTANT?

(Answer: It makes possible protection of public health and the environment . . . AND delivers important economic benefits as well)

Jeffrey C. Smith, *Executive Director*

The most important reason for the environmental products (EP) industry is that its technology and services help our Nation achieve the environmental goals which poll after poll shows the public supports. These goals seek to improve the health of Americans and the environment on which we depend so fewer Americans get sick or die, health care costs decline, business productivity improves, building and materials damage is reduced, and ecosystems are preserved for current and future generations.

The U.S. EP industry delivers real economic benefits: over 1.3 million U.S. jobs and a trade surplus.[1] These jobs are widely dispersed throughout the states, and occur in many sectors of the economy as well.[2] Many are high-tech, such as engineering and computer-aided design, others involve traditional manufacturing, transport, and communication.[3] Only 11% of EP industry jobs are governmental, compared to 17% economy-wide.[4]

Numerous, rigorous studies conclude that environmental protection is compatible with and can even aid economic growth,[5] and that environmentally-regulated industries do better than others.[6] Studies speculate that investing in clean air technology stimulates the investment in more productive technology generally.[7] In fact, improved environmental performance can increase a firm's stock value from 5%[8] to as much as 10%[9]. From 1990-1995, there was a net gain of 2.2 million jobs in nonattainment areas (which must achieve the greatest air quality improvements), and 63% of those areas had average annual employment growth rates greater than that of their region of the country.[10] Even in Los Angeles, site of the most costly air pollution control rules in the Nation, researchers found the rules caused a slight net *positive* effect on employment.[11] Nationwide, from 1970-1997, emissions of the six criteria pollutants declined 31%, while U.S. population increased 31%, GDP increased 114%, and vehicle miles traveled increased 127%.[12]

Moreover, the U.S. EP industry, including air pollution controls, is generating a trade surplus of over $9 billion.[13] The U.S. EP industry exports almost 10% of the total goods and services it produces, and these environmental exports have doubled since 1993.[14] This U.S. EP industry should be one of the world's fastest growing, and promises to provide even greater economic benefits to our Nation in the future. Exports of the U.S. EP industry also further our Nation's foreign affairs objectives regarding global environmental protection. Finally, ensuring a domestic EP industry guarantees cheaper, better products for regulated U.S. industry than would dependence on foreign suppliers, as shown by the U.S. EP industry's reductions in the cost of controls, and simultaneous improvements in performance and reliability.[15]

Notes:

1. U.S. Department of Commerce, *Environmental Industry of the United States*, January 1999.
2. Id.; Institute of Clean Air Companies (ICAC) and U.S. EPA, *Employment Created by NO_x Control and Continuous Emission Monitoring Requirements of Title IV of the 1990 Clean Air Act Amendments*, March 1994, passim.

Notes (cont'd):

3. Id.
4. Goodstein, E.B., *Jobs and the Environment*, Economic Policy Institute, 1994, pp. 7-12
5. E.g., Goodstein, supra n. 4; Meyer, S., *Environmentalism and Prosperity: Testing the Environmental Impact Hypothesis*, MIT, 1992; Meyer, S., *Environmentalism and Prosperity: An Update*, MIT, 1993; Templet, P.H., *The Complementary Nature of Environment and Economy*, Environmental Science & Technology (American Chemical Society), vol. 27, 1993; Wendling, R.M. and Bezdek, R.H., *Acid Rain Abatement Legislation: Costs and Benefits*, OMEGA International Journal of Management Science, vol. 17, 1989.
6. Repetto, R., *Jobs, Competitiveness, and Environmental Regulation: What Are the Real Issues?*," World Resources Institute, 1995.
7. Business Week, *Do Pollution Regs Cost Jobs?* November 16, 1998.
8. Feldman, S.J., Soyka, P.A., and Ameer, P., *Does Improving a Firm's Environmental Management System & Environmental Performance Result in a Higher Stock Price*, ICF Kaiser International, Inc., January 1997.
9. Dow Jones Newswires, *KPMG Survey on Environmental Reporting*, September 1, 1999.
10. U.S. Environmental Protection Agency, *Urban Air Toxics Strategy Briefing Document*, September 1, 1998.
11. Business Week, supra, n. 7.
12. U.S. Environmental Protection Agency, *National Air Quality Trends Report, 1997*, December 1998.
13. U.S. Department of Commerce, supra n. 1, p. 3.
14. Id.
15. E.g., ICAC, *White Paper: Selective Catalytic Reduction Controls to Abate NO_x Emissions*, November 1997; *White Paper: Selective Non-Catalytic Reduction (SNCR) for Controlling NO_x Emissions*, October 1997; ICAC, *White Paper: Scrubber Myths & Realities*, May 1995; ICAC.